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Quite a few mobile phone-based payment systems promising to change the world have been launched with some fanfare. Not many have gained sufficient traction. The familiar sight of cash registers still dominate retail outlets, bearing witness to the lack of widespread popularity (or failure) of mobile payment systems. While certain niche markets, like Japan, are already using various types of mobile phone-based payment systems, they remain, alas, a niche. Cash, coins and credit cards are not likely to go away soon.

The case for cashless payments via mobile phones has proven to be an exceptionally challenging problem to crack; even harder to make money from. A group of researchers, led by professors Rajesh Krishna Balan (http://www.sis.smu.edu.sg/faculty/infosys/rajesh.asp) and Narayan Ramasubbu (http://www.sis.smu.edu.sg/faculty/infosys/nramasub.asp) from SMU's School of Information Systems (http://www.sis.smu.edu.sg/index.asp), have identified the hindering factors. More importantly, they have also designed mFerio, a mobile payment system which promises better user acceptance.

Battling with cash

There are significant barriers to entry for payment systems using mobile phones. As it seeks to replace cash as a means of transaction, there are many requirements to satisfy. Cash, for one, is easy to use. It is also difficult to trace (anonymous), predictable, fast and accountable. Therefore, mobile payment systems would have to be simple and robust enough to be widely accepted and acknowledged – to give cash a good run for the money, so to speak.

Up to now, mobile phone-based payment schemes have failed to take off due to one key disadvantage - the general lack of supporting infrastructure. When connections to the host or payment servers drop or encounter delays, user experience suffers and security risks might crop up.

Also, unlike cash, the introduction and maintenance of such systems represent additional costs to the merchants, thus creating another barrier to entry. Such 'points of failure' reduce the overall robustness and usability of the system. No wonder it has not taken off despite early attempts!

Ground up design

Enter mFerio, a peer-to-peer (p2p) mobile phone payment system. The paper, "mFerio: The Design and Evaluation of a Peer-to-Peer Mobile Payment System", was presented recently at the 7th International Annual International Conference on Mobile Systems, Applications and Services (MobiSys 2009), at Krakow, Poland.

"mFerio can be implemented on smartphones, does not require any additional connectivity or infrastructure beyond the mobile phones of the participants, and was designed with usability and security in mind," the authors wrote. Designed as a p2p system from the ground up, mFerio sidesteps issues of infrastructure, as well as associated financial and performance costs.

As a light-weight and secure transaction system, mFerio relies on a digital wallet protocol in a mobile phone to store value, and to securely transfer it to another phone. The design decision was centred on the choice of a suitable digital wallet protocol – one that can achieve that fine balance between security and ease of use. So the researchers focused on existing protocols, rather than attempting to reinvent the wheel.

The relatively mature *Even-Goldreich-Yacobi protocol* was chosen because it represented a low performance overhead, coupled with divisible digital cash units, which made payments and accounting for those payments easy.

The two-touch payment protocol, for instance, uses an existing electronic wallet system to authenticate the identities of the transacting parties (1st touch) as well as to complete the transaction itself (2nd touch).

"Atomicity" for security

An additional feature of "atomicity" enhances security. This means that should the transaction fail at any point, the original state (with the pre-transaction amounts of digital cash) is returned to both the transacting parties. This feature gives users the assurance that their cash will not be 'lost in space' when transactions fail. At the very worst, users merely have to re-do their transactions.

The use of near field communications (NFC) for the transmission protocol was a deliberate choice to enhance security. Current approaches, many of which depend on Bluetooth and other similar protocols, run risks of being intercepted. In contrast, NFC, because of its very low power requirements, usually operate at a very short range (between 2.5 to 5cm), making it both private and hard for anyone to send out wireless packet sniffers to detect or intercept the transactions.

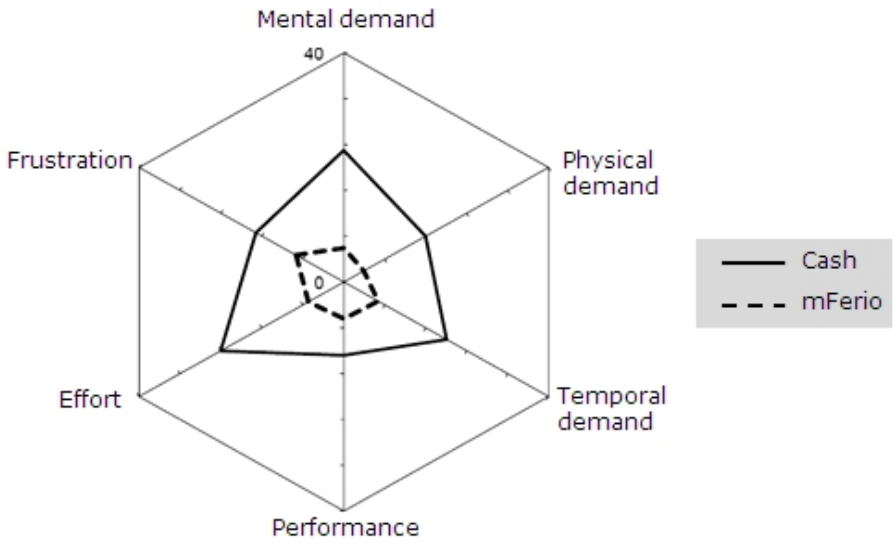
By moving the onus of user authentication from the unseen infrastructure to the transacting individuals, mFerio mimics cash more closely, compared to previous attempts at digital payment – just as how, in cash transactions, people will usually check to see if they have paid the right amount and got the correct change back.

Feedback and prompts from the phone screens assures users of the progress and security of transactions. The researchers believe that by matching users' cognitive load to that of cash transactions, the payment experience will feel more comfortable, and hence, agreeable with users.

To test their system, Balan and Ramasubbu hired a group of 104 students and staff, comprising a mix of both technical and non-technical majors, with varying levels of self-professed expertise in using mobile phone applications. The test subjects were asked to perform simple transaction tasks with mFerio, and to compare them with using cash, in terms of time needed, effort, ease of use, and cognitive workload to track the transaction from beginning to end.

In addition, users were asked to rank, on a five-point Likert scale, how the experience compared with cash. In a surprising result, the researchers found that mFerio had outperformed cash in terms of cognitive load - it was easier to track the transaction performed on mFerio versus cash.

Graph: Cash versus mFerio [2B workload]



An example is illustrated below:

User initiates a payment.

(a) The user first 'authenticates' himself or herself with a biometric fingerprint reader

(b) Chooses to pay someone

a)

b)

(c) Selects a reason from a predefined list, and enters an amount to pay

(d) The user sees the amount to be paid

c)

d)

(e) The user touches her phone with the recipient's phone, and then

(f) Confirms the payment.

e)

f)

Once confirmed, the user (g) finalises the payment, and then (h) gets a receipt.

g)

h)

Source: R.K. Balan et al. mFerio: the design and evaluation of a peer-to-peer mobile payment system. ACM 2009, 291-304

Going forward

What's next for this digital payment scheme? The researchers say that plans to take mFerio further in any market will depend on the blessing of relevant regulatory authorities and the alignment of commercial interests for its promotion.

The industry in Singapore had seen various attempts. Some pilots, under the auspices of industry regulator, the Infocomm Development Authority (IDA), are underway. But, challenges remain. For one, the various pieces that together make up the ecosystem need to be in place.

"A successful mFerio deployment will require cooperation from multiple stakeholders, such as banks (to support the digital cash used), cellphone manufacturers and telecom service providers (to provide mFerio to their customers), retailers, regulatory bodies (to legalise p2p payments), and consumers," the authors wrote.

"Unfortunately, satisfying the business and strategic goals of multiple stakeholders is very difficult and achieving sufficient buy-in may require governmental and regulatory body support," they caution.

It is important to ensure the mass market appeal of this system - not only for economies of scale, but also, to tap on network externality effect, where mobile phone users are more likely to utilise mFerio if the people around them (in other words, the transaction counter parties) are also on mFerio.

Nevertheless, there are reasons to be upbeat. In Singapore, key 'ingredients', such as high mobile phone penetration, is already in place. According to figures compiled by IDA, mobile penetration rate as of July 2009 was 136%, which means there are some people holding onto more than one mobile phone. Out of the total mobile subscription of 6,581,100, more than 40% are on 3G (next generation, faster speed) subscriptions of the more advanced variety.

The base for the demographic most likely to be 'early adopters' of such schemes also favours Singapore, whose tech-savvy young have been long used to a diet of mobile internet. To them, mFerio will likely seem as a mere extension of what they already do online. Young people, already used to the idea of digital cash, for example in online gaming communities as tokens, would likely be the first to be comfortable with and use this type of payment modes.

Banks – critical components in any financial system – have to be involved too. For when the mobile phone runs out of 'cash' in its digital wallet, users will need to top it up at a financial institution that can provide links to the users' financial records held in a bank.

Many of the major banks in Singapore already offer internet banking services, which currently enjoy widespread usage, so significant pieces of the infrastructure required are already available, and can be re-purposed for this application.

Finally, the local banking regulatory environment will be a decisive element in the success or failure of such a scheme. There needs to be legislation and institutional recognition supportive of digital cash on mobile devices.

When the day comes, hopefully, in the not too distant future, Singaporeans can look forward to buying *roti prata* and *nasi goreng* with the gusto of a few simple clicks on their own handheld device, instead of digging into pockets for spare change.

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